Express Mail Label No. EV 420 566 379 US

Date of Mailing: April 14, 2004

PATENT
**Case No. GP-304688**
(2760/170)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
APPLICATION FOR UNITED STATES LETTERS PATENT

INVENTOR(S): NADA S. JIDDOU
WILLIAM E. MAZZARA, JR.

TITLE: TIME ZONE BASED GPS DATE AND TIME

ATTORNEYS: ANTHONY LUKE SIMON, ESQ.
GENERAL MOTORS CORPORATION
LEGAL STAFF
MAIL CODE: 482-C23-B21
300 RENAISSANCE CENTER
P.O. BOX 300
DETROIT, MICHIGAN 48265-3000
(313) 665-4714

# TIME ZONE BASED GPS DATE AND TIME

## FIELD OF THE INVENTION

The invention relates to vehicles, and more particularly to methods and systems for obtaining local time and date information for a vehicle.

## BACKGROUND OF THE INVENTION

A growing number of vehicles are equipped with telematic devices as part of a mobile vehicle communication system, which provides voice and data communication with the vehicle. Such telematic devices are typically equipped with Global Positioning Systems (GPSs) using satellite technology to allow determination of the vehicle's location. The GPS signal also provides a time and date under the Coordinated Universal Time (UTC) standard, which provides a single time regardless of the geographical location in the world.

All activity involving the telematic devices is presently based on the UTC time without regard for the local time at the vehicle location. This presents problems because some tasks are better performed in off hours when the vehicle is not likely to be in use, while other tasks are better performed when the vehicle is likely to be in use. For example, Vehicle Data Uploads (VDUs) transfer stored mobile vehicle data from the telematic devices to a centralized data storage location. VDUs are performed simultaneously at a single UTC time for all the telematic devices in a large geographic region. The mobile vehicle communication system must be sized to carry this peak traffic, although the system capacity is unused most of the time. Meeting the peak traffic increases costs and design complexity.

It would be desirable to have a method and system for obtaining local time and date information for a vehicle that overcomes the above disadvantages.

SUMMARY OF THE INVENTION

The present invention provides a method for determining a time zone based date and time from a Global Positioning System (GPS) signal, the method including receiving a time zone reference signal at a telematics device, determining a local Coordinated Universal Time (UTC) correction from the time zone reference signal, storing the local UTC correction, and calculating local time from the local UTC correction and the GPS signal.

Another aspect of the present invention provides a system for determining a time zone based date and time from a Global Positioning System (GPS) signal, the system including means for receiving a time zone reference signal at a telematics device, means for determining a local Coordinated Universal Time (UTC) correction from the time zone reference signal, means for storing the local UTC correction, and means for calculating local time from the local UTC correction and the GPS signal.

Yet another aspect of the present invention provides a computer readable medium storing a computer program for determining a time zone based date and time from a Global Positioning System (GPS) signal, the computer program including computer readable code for receiving a time zone reference signal at a telematics device, computer readable code for determining a local Coordinated Universal Time (UTC) correction from the time zone reference signal, computer readable code for storing the local UTC correction, and computer readable code for calculating local time from the local UTC correction and the GPS signal.

The foregoing and other features and advantages of the invention will become further apparent from the following detailed description of the presently preferred embodiment, read in conjunction with the accompanying drawings. The detailed description and drawings are merely illustrative of the invention rather than limiting, the scope of the invention being defined by the appended claims and equivalents thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an illustrative operating environment for determining a time zone based date and time from a Global Positioning System (GPS) signal in accordance with the present invention.

FIG. 2 is a process flow diagram for determining a time zone based date and time from a Global Positioning System (GPS) signal in accordance with the present invention.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENT

FIG. 1 is an illustrative operating environment for determining a time zone based date and time from a Global Positioning System (GPS) signal in accordance with the present invention. FIG. 1 shows a mobile vehicle communication system **100**. Mobile communication system **100** includes at least one mobile vehicle **110** (vehicle) including vehicle communication bus **112** and telematics device **120**, one or more wireless carrier systems **140**, one or more communication networks **142**, one or more land networks **144**, one or more client, personal or user computers **150**, one or more web-hosting portals **160**, and one or more call centers **170**. In one embodiment, mobile vehicle **110** is implemented as a vehicle equipped with suitable hardware and software for transmitting and receiving voice and data communications. The telematics device **120** is also called a vehicle communications unit (VCU) or a telematics unit.

In one embodiment, the telematics device **120** includes a processor **122** connected to a wireless modem **124**, a global positioning system (GPS) unit **126**, an in-vehicle memory **128**, such as, for example, a non-volatile flash memory, a microphone **130**, one or more speakers **132**, and an embedded or in-vehicle mobile phone **134**. In one embodiment, processor **122** is a microcontroller, controller, host processor, or vehicle communications processor. In an example, processor **122** is implemented as an application specific integrated circuit (ASIC).

In another example, processor **122** is a digital signal processor (DSP). GPS unit **126** provides longitude and latitude coordinates of the vehicle, as well as a time and date stamp. In-vehicle mobile telephone system **134** is a cellular-type phone, such as, for example an analog, digital, dual-mode, dual-band, multi-mode or multi-band cellular phone. In another example, the mobile telephone system is an analog mobile telephone system operating over a prescribed band nominally at 800 MHz. In another example, the mobile telephone system is a digital mobile telephone system operating over a prescribed band nominally at 800 MHz, 900 MHz, 1900 MHz, or any suitable band capable of carrying digital cellular communications.

Processor **122** executes various computer programs and communication control and protocol algorithms that affect communication, programming and operational modes of electronic and mechanical systems within vehicle **110**. In one embodiment, processor **122** is an embedded system controller. In another embodiment, processor **122** controls communications between telematics device **120**, wireless carrier system **140**, and call center **170**. In yet another embodiment, processor **122** controls communications between the wireless modem **124** and nodes of a mobile ad hoc network. In still another embodiment, processor **122** provides processing, analysis and control functions for determining engine emission performance for vehicle **110**. Processor **122** is configured to generate and receive digital signals transmitted between telematics device **120** and a vehicle communication bus **112** that is connected to various electronic modules in the vehicle **110**. In one embodiment, the digital signals activate a programming mode and operation modes, as well as provide for data transfers. In another embodiment, a utility program facilitates the transfer of emission data, emission analysis data, instructions, triggers and data requests between vehicle **110** and a call center **170**.

Mobile vehicle **110**, via a vehicle communication bus **112**, sends signals to various units of equipment and systems within vehicle **110** to perform various functions such as monitoring the operational state of vehicle systems, collecting and storing data from the vehicle systems, providing instructions, data and programs to various vehicle systems and calling from telematics device **120**. In facilitating interactions among the various communication and electronic modules, vehicle communication bus **112** utilizes bus interfaces such as controller-area network (CAN), International Organization for Standardization (ISO) Standard 9141, ISO Standard 11898 for high-speed applications, ISO Standard 11519 for lower speed applications, and Society of Automotive Engineers (SAE) standard J1850 for higher and lower speed applications. In one embodiment, vehicle communication bus **112** is a direct connection between connected devices.

Vehicle **110**, via telematics device **120**, sends and receives radio transmissions from wireless carrier system **140**. Wireless carrier system **140** is implemented as any suitable system for transmitting a signal from mobile vehicle **110** to communication network **142**. Wireless carrier system **140** incorporates any type of telecommunications in which electromagnetic waves carry signal over part of or the entire communication path. In one embodiment, wireless carrier system **140** transmits analog audio and/or video signals. In an example, wireless carrier system **140** transmits analog audio and/or video signals such as those sent from AM and FM radio stations and transmitters, or digital audio signals in the S band (approved for use in the U.S.) and L band (used in Europe and Canada). In one embodiment, wireless carrier system **140** is a satellite broadcast system broadcasting over a spectrum in the "S" band (2.3 GHz) that has been allocated by the U.S. Federal Communications Commission (FCC) for nationwide broadcasting of satellite-based Digital Audio Radio Service (DARS).

Communication network **142** includes services from one or more mobile telephone switching offices and wireless networks. Communication network **142** connects wireless carrier system **140** to land network **144**. Communication network **142** is implemented as any suitable system or collection of systems for connecting wireless carrier system **140** to mobile vehicle **110** and land network **144**. In one example, wireless carrier system **140** includes a short message service, modeled after established protocols such as IS-637 SMS standards, IS-136 air interface standards for SMS, and GSM 03.40 and 09.02 standards. Similar to paging, an SMS communication could be broadcast to a number of regional recipients. In another example, the carrier system **140** uses services in accordance with other standards, such as, for example, IEEE 802.11 compliant wireless systems and Bluetooth compliant wireless systems.

Land network **144** is a public-switched telephone network (PSTN). In one embodiment, land network **144** is implemented as an Internet protocol (IP) network. In other embodiments, land network **144** is implemented as a wired network, an optical network, a fiber network, another wireless network, a virtual private network (VPN) or any combination thereof. Land network **144** is connected to one or more landline telephones. Land network **144** connects communication network **142** to user computer **150**, web-hosting portal **160**, and call center **170**. Communication network **142** and land network **144** connect wireless carrier system **140** to web-hosting portal **160** and call center **170**.

Client, personal or user computer **150** includes a computer usable medium to execute Internet browser and Internet-access computer programs for sending and receiving data over land network **144** and optionally, wired or wireless communication networks **142** to web-hosting portal **160** and vehicle **110**. Personal or user computer **150** sends data to web-hosting portal through a web-page interface using communication standards such as hypertext transport protocol (HTTP), and transport-control protocol Internet protocol (TCP/IP). In one embodiment, the data includes directives to change certain programming

and operational modes of electronic and mechanical systems within vehicle **110**. In another embodiment, the data includes requests for certain data such as vehicle system performance information. In operation, a user, such as, for example, a vehicle designer or manufacturing engineer, utilizes user computer **150** to exchange information with mobile vehicle **110** that is cached or stored in web-hosting portal **160**. In an embodiment, vehicle system performance information from client-side software is transmitted to server-side software of web-hosting portal **160**. In one embodiment, vehicle system performance information is stored at web-hosting portal **160**. In another embodiment, client computer **150** includes a database (not shown) for storing received vehicle system performance data. In yet another embodiment, a private Local Area Network (LAN) is implemented for client computer **150** and web-hosting portal **160**, such that web-hosting portal is operated as a Virtual Private Network (VPN).

Web-hosting portal **160** includes one or more data modems **162**, one or more web servers **164**, one or more databases **166**, and a network **168**. Web-hosting portal **160** is connected directly by wire to call center **170**, or connected by phone lines to land network **144**, which is connected to call center **170**. Web-hosting portal **160** is connected to land network **144** by one or more data modems **162**. Land network **144** sends digital data to and from modem **162**; data that is subsequently transferred to web server **164**. In one implementation, modem **162** resides inside web server **164**. Land network **144** transmits data communications between web-hosting portal **160** and call center **170**.

Web server **164** receives various data, requests or instructions from user computer **150** via land network **144**. In alternative embodiments, user computer **150** includes a wireless modem to send data to web-hosting portal **160** through a wireless communication network **142** and a land network **144**. Data is received by modem **162** and sent to one or more web servers **164**. In one embodiment, web server **164** is implemented as any suitable hardware and software capable of providing web services to transmit and receive data from user computer **150** to

telematics device **120** in vehicle **110**. Web server **164** sends to or receives data transmissions from one or more databases **166** via network **168**. In an embodiment, web server **164** includes computer applications and files for managing emission performance data.

In one embodiment, one or more web servers **164** are networked via network **168** to distribute vehicle engine emission performance data among its network components such as database **166**. In an example, database **166** is a part of or a separate computer from web server **164**. In one embodiment, web-server **164** sends data transmissions including vehicle system performance information to call center **170** via modem **162**, and through land network **144**.

Call center **170** is a location where many calls are received and serviced at the same time, or where many calls are sent at the same time. In one embodiment, the call center is a telematics call center, facilitating communications to and from telematics device **120** in vehicle **110**. In an example, the call center is a voice call center, providing verbal communications between an advisor in the call center and a subscriber in a mobile vehicle. In another example, the call center contains each of these functions. In other embodiments, call center **170** and web-hosting portal **160** are located in the same or different facilities.

Call center **170** contains one or more voice and data switches **172**, one or more communication services managers **174**, one or more communication services databases **176**, one or more communication services advisors **178**, and one or more networks **180**.

Switch **172** of call center **170** connects to land network **144**. Switch **172** transmits voice or data transmissions from call center **170**, and receives voice or data transmissions from telematics device **120** in mobile vehicle **110** through wireless carrier system **140** and/or wireless modem **124**, communication network **142**, and land network **144**. Switch **172** receives data transmissions from, and sends data transmissions to, one or more web-hosting portals **160**. Switch **172** receives data transmissions from, or sends data transmissions to, one or more communication services managers **174** via one or more networks **180**.

Communication services manager **174** is any suitable hardware and software capable of providing communication services to telematics device **120** in mobile vehicle **110**. Communication services manager **174** sends to or receives data transmissions from one or more communication services databases **176** via network **180**. Communication services manager **174** sends to or receives data transmissions from one or more communication services advisors **178** via network **180**. Communication services database **176** sends to or receives data transmissions from communication services advisor **178** via network **180**. Communication services advisor **178** receives from or sends to switch **172** voice or data transmissions.

Communication services manager **174** facilitates one or more services, such as, but not limited to, enrollment services, navigation assistance, directory assistance, roadside assistance, business or residential assistance, information services assistance, emergency assistance, and communications assistance and telematics retrieval of vehicle system performance information. In an embodiment, communication services manager **174** receives service requests for a vehicle emission performance data update from a user via user computer **150**, web-hosting portal **160**, and land network **144**. Communication services manager **174** transmits and receives operational status, instructions and other types of vehicle data to telematics device **120** in mobile vehicle **110** through wireless carrier system **140**, communication network **142**, land network **144**, wireless modem **124**, voice and data switch **172**, and network **180**.

Communication services manager **174** stores or retrieves vehicle system performance information from communication services database **176**. Communication services manager **174** provides requested information to communication services advisor **178**.

In one embodiment, communication services advisor **178** is a real advisor. In another embodiment, communication services advisor **178** is implemented as a virtual advisor. In an example, a real advisor is a human being at service provider service center in verbal communication with service subscriber in mobile vehicle **110** via telematics device **120**. In another example, a virtual advisor is implemented as a synthesized voice interface responding to requests from telematics device **120** in mobile vehicle **110**. In another embodiment, communication services advisor **178** is embodied in software executing on a computing system that provides automated configurable dynamic telematic retrieval of vehicle system performance information.

Communication services advisor **178** provides services to telematics device **120** in mobile vehicle **110**. Services provided by communication services advisor **178** include enrollment services, navigation assistance, real-time traffic advisories, directory assistance, roadside assistance, business or residential assistance, information services assistance, emergency assistance, and communications assistance. Communication services advisor **178** communicates with telematics device **120** in mobile vehicle **110** through wireless carrier system **140**, communication network **142**, and land network **144** using voice transmissions, or through communication services manager **174** and switch **172** using data transmissions. Switch **172** selects between voice transmissions and data transmissions.

Mobile vehicle **110** initiates service requests to call center **170** by sending a voice or digital-signal command to telematics device **120** which in turn, sends an instructional signal or a voice call through wireless modem **124**, wireless carrier system **140**, communication network **142**, and land network **144** to call center **170**. In another embodiment, the service request is for an vehicle system performance information upload that initiates a vehicle system performance information transfer between vehicle **110** and service center **170** or web-hosting portal **160**. In another embodiment, the mobile vehicle **110** receives a request from call center **170** to send various types of vehicle system performance information from mobile vehicle **110** through telematics device **120** through wireless modem **124**, wireless modem **124**, wireless carrier system **140**, communication network **142**, and land network **144** to call center **170**. In one embodiment, one or more triggers stored in the telematics device **120** cause the vehicle to initiate a service request. The trigger is, for example, a number of ignition cycles, a specific time and date, an expired time, a number of kilometers, an absolute Global Positioning System (GPS) timestamp, a request vehicle emission performance data and the like.

FIG. 2 is a process flow diagram for determining a time zone based date and time from a Global Positioning System (GPS) signal in accordance with an embodiment of the present invention. The method **200** includes receiving a time zone reference signal at a telematics device **202**, determining a local Coordinated Universal Time (UTC) correction from the time zone reference signal **204**, storing the local UTC correction **206**, and calculating local time from the local UTC correction and the GPS signal **208**. As used herein, time includes both time-of-day and date information.

Receiving a time zone reference signal at a telematics device **202** is performed once or multiple times depending on the local time calculation that is desired, such as whether the local time is the mobile vehicle's home location time or current location time.

In one embodiment, the local time is the time at the mobile vehicle's home location and does not change with the vehicle's day-to-day location. The reception of a time zone reference signal at a telematics device **202** is performed for the initial telematics device configuration for the first vehicle owner, telematics device reconfigurations for subsequent vehicle owners, or telematics device configurations with changes in the mobile vehicle's home location. In one embodiment, the local time at the mobile vehicle's home location is checked by later reception of the time zone reference signal.

In an alternative embodiment, the local time is the time at the mobile vehicle's current location and changes with the vehicle's current location. The reception of a time zone reference signal at a telematics device **202** is performed intermittently or regularly on a vehicle triggered event or a system triggered event. Vehicle triggered events are triggered by an event at the mobile vehicle, such as starting the vehicle or periodic signals from a vehicle timer. System triggered events are triggered by an event in the rest of the mobile vehicle communication system, such as an event at the computer, web-hosting portal, or the call center. Examples of system triggered events are communication services advisor requests and periodic signals from a system timer. Those skilled in the art will appreciate that the local time as the time at the mobile vehicle's home location is desirable for some functions and local time as the time at the mobile vehicle's current location is desirable for other functions. In one embodiment, both the time at the mobile vehicle's home location and the time at the mobile vehicle's current location are available for different functions in the mobile vehicle communication system.

Determining a local Coordinated Universal Time (UTC) correction from the time zone reference signal **204** depends on the type of time zone reference signal, such as a GPS signal or a Code Division Multiple Access (CDMA) signal.

In one embodiment, the time zone reference signal is a GPS signal, which includes both position information (longitude and latitude) and the current time under the UTC standard. The GPS unit of the telematics device of a mobile vehicle receives the GPS signal from Global Positioning System (GPS) satellites. The vehicle location (longitude and latitude) of the mobile vehicle is determined from the GPS signal and the local time zone determined from the vehicle location. In one embodiment, the local time zone is determined by looking up the local time zone in a table with time zone indexed by longitude and latitude. In an alternative embodiment, the local time zone is determined using an algorithm providing time zone as a function of longitude and latitude.

Once the local time zone has been determined, the local Coordinated Universal Time (UTC) correction for the local time zone is determined. In one embodiment, the local UTC correction is looked up on a table with local UTC correction indexed by local time zone. In one embodiment, the determination of a local Coordinated Universal Time (UTC) correction from the GPS signal is performed at the telematics device. In an alternative embodiment, the determination of a local Coordinated Universal Time (UTC) correction from the GPS signal is performed elsewhere in the mobile vehicle communication system, such as the web-hosting portal or the call center. The GPS signal as received at the mobile vehicle is typically available throughout the mobile vehicle communication system to allow determination of the vehicle location for driver assistance.

In an alternative embodiment, the time zone reference signal is a Code Division Multiple Access (CDMA) signal. The CDMA signal includes CDMA time, UTC time, and CDMA local time correction. The CDMA time is calculated from the UTC time obtained from the GPS satellites and the CDMA local time correction. During configuration of the telematics device for a particular mobile vehicle, the UTC time is determined from the GPS signal received at the GPS unit of the telematics device. The CDMA signal including the CDMA time from

the wireless carrier system is also received at the telematics device. The local UTC correction is determined by taking the difference between the UTC time and the CDMA time. In an alternative embodiment, the local UTC correction is determined directly by setting the local UTC correction equal to the CDMA local time correction.

The local UTC correction is stored **206** for use in calculating local time from the local UTC correction and the GPS signal. The local UTC correction is stored in one or more locations depending on where it is most convenient for use, although each portion of the mobile vehicle communication system is able to access the other storage locations. In one embodiment, the local UTC correction is stored in an in-vehicle memory in the mobile vehicle. In an alternative embodiment, the local UTC correction is stored in a web-hosting portal database at the web-hosting portal. In yet another alternative embodiment, the local UTC correction is stored in a communications services database at the call center.

Local time is calculated from the local UTC correction and the GPS signal **208**. The GPS signal includes the UTC time, so the calculation of the local time performed by adding (or subtracting, as appropriate) the local UTC correction and the UTC time.

The local time is used to schedule mobile vehicle communication system activities. The communication is from the telematics device to elsewhere in the mobile vehicle communication system or vice versa.

In one embodiment, the local time is used to schedule Vehicle Data Uploads (VDUs), which transfer stored mobile vehicle data from the telematics device to the web-hosting portal and/or the call center. The VDUs for a group of vehicles in a geographic region are assigned various local times to reduce the peak data traffic on the mobile vehicle communication system. Scheduling the VDU at a local time when there is little activity, such as in the middle of the night, allows efficient use of available bandwidth in the mobile vehicle communication system.

In an alternative embodiment, the local time is used to schedule communication from the web-hosting portal and/or the call center to the telematics device in the mobile vehicle. In one example, the user of the vehicle schedules a user requested notice, such as an alarm or reminder, to be delivered to the mobile vehicle from the web-hosting portal or the call center at a user desired local time. The telematics device announces or displays the user requested notice at the desired local time. In another example, the web-hosting portal or the call center schedules a system scheduled notice, such as an announcement or event notice, to be delivered to the telematics device of the mobile vehicle at or before the local time the user of the vehicle is likely to use the vehicle and receive the system scheduled notice. Such system scheduled notices include, but are not limited to vehicle service notifications, advertisements, weather reports and bulletins, traffic conditions, stock reports, and the like. Those skilled in the art will appreciate that the local time is used to schedule any transmission to or from the telematics device for which a specific local time is desired.

While the embodiments of the invention disclosed herein are presently considered to be preferred, various changes and modifications can be made without departing from the scope of the invention. The scope of the invention is indicated in the appended claims, and all changes that come within the meaning and range of equivalents are intended to be embraced therein.